



United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

REPORT OF CALIBRATION

June 20, 1978

of Aerial Mapping Camera

Camera type	<u>Wild Heerbrugg RC10</u>	Camera serial no.	<u>2035 (Modified)</u>
Lens type	<u>Wild Super-Aviogon II</u>	Lens serial no.	<u>SAG II 2035</u>
Nominal focal length	<u>88 mm</u>	Maximum aperture	<u>f/5.6</u>
		Test aperture	<u>f/8</u>

Submitted by

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Reference: Mark Hurd Purchase Order No. 8785 dated June 12, 1978

These measurements were made on Kodak micro flat glass plates, 0.25 inch thick with spectroscopic emulsion type V-F Panchromatic, developed in D-19 at 68°F for 3 minutes with continuous agitation. These photographic plates were exposed on a multicollimator camera calibrator using a white light source rated at approximately 3500K.

I. Calibrated Focal Length: 87.724 mm

This measurement is considered accurate within 0.02 mm

II. Radial Distortion:

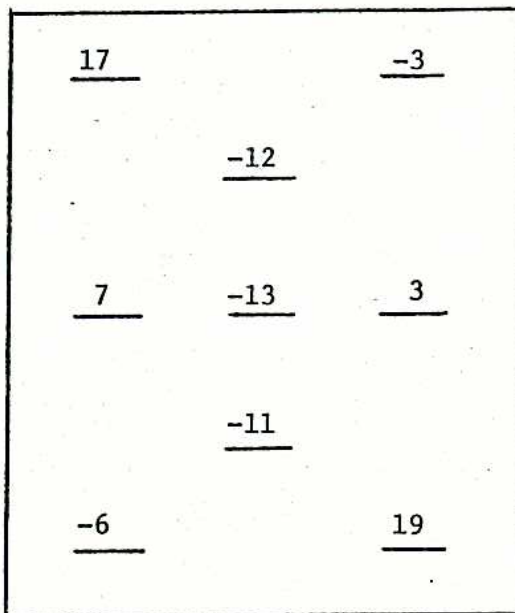
Field angle (degrees)	\bar{D}_c	D_c for azimuth angle			
		0° A-C	90° A-D	180° B-D	270° B-C
		μm	μm	μm	μm
7.5	11.6	0	0	0	1
15	23.6	-1	-2	-1	0
22.5	36.5	-5	-3	-5	-4
30	56.8	-6	-5	-6	-6
35	61.6	-6	-4	-7	-5
40	73.8	-5	0	-5	-4
45	88	1	5	-1	2
50	109.87	10	16	10	9
54.5	123.4	2	3	-6	12

The radial distortion is measured for each of 4 radii of the focal plane separated by 90° in azimuth. To minimize plotting error due to distortion, a full least-squares solution is used to determine the calibrated focal length. \bar{D}_c is the average distortion for a given field angle. Values of distortion D_c based on the calibrated focal length referred to the calibrated principal point (point of symmetry) are listed for azimuths 0°, 90°, 180°, and 270°. The radial distortion is given in micrometres and indicates the radial displacement of the image from its ideal position for the calibrated focal length. A positive value indicates a displacement away from the center of the field. These measurements are considered accurate within 5 μm .

APPENDIX B

STEREOMODEL FLATNESS TEST AND FILM RESOLUTION

Camera No. 2035 Lens No. Sag II 2035 Magazine No. 52-468
 Focal length 87.724 mm Maximum angle of field tested 54.5°
 Base-height ratio 1.0 Accuracy of determination 5 μm



Stereomodel
 Test point array
 (values in micrometres)

The values shown on the diagram are the average departures from flatness (at negative scale) for two computer-simulated stereomodels based on comparator measurements on contact glass (Kodak micro flat) diapositives made from Kodak 2405 film exposures.

Resolving Power, in cycles/mm Area-weighted average resolution 31.0
 Film: Type 2405

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°	45°	50°	54.5°
Radial lines	70	59	42	42	42	59	59	24	17	17
Tangential lines	70	59	42	30	24	24	24	42	42	30

This report supersedes the previous calibration of this camera contained in USGS Report of Calibration No. 104, dated August 13, 1974.

William P. Tayman
 William P. Tayman
 Branch of Research and Design
 Topographic Division

III. Resolving power in cycles/mm Area-weighted average resolution 41.2

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°	45°	50°	54.5°
Radial lines	83	70	49	42	49	83	99	30	17	17
Tangential lines	83	70	49	42	35	30	42	70	59	42

The resolving power is obtained by photographing a series of test bars and examining the resulting image with appropriate magnification to find the spatial frequency of the finest pattern in which the bars can be counted with reasonable confidence. The series of patterns has spatial frequencies from 9 to 470 cycles/mm in a geometric series having a ratio of the 4th root of 2. Radial lines are parallel to a radius from the center of the field, and tangential lines are perpendicular to a radius.

IV. Filter Parallelism

The two surfaces of the 505 Pan No. 4149 filter accompanying this camera are within ten seconds of being parallel. This filter was used for the calibration.

V. Shutter Calibration

<u>Indicated shutter speed</u>	<u>Effective shutter speed</u>	<u>Efficiency</u>
1/200	6.2 ms = 1/160s	80%
1/400	3.0 ms = 1/330s	80%
1/600	2.0 ms = 1/500s	80%
1/800	1.5 ms = 1/670s	80%
1/1000	1.2 ms = 1/830s	80%

The effective shutter speeds were determined with the lens at aperture f/8. The method is considered accurate within 3%. The technique used is Method I described in American National Standard PH3.48-1972.

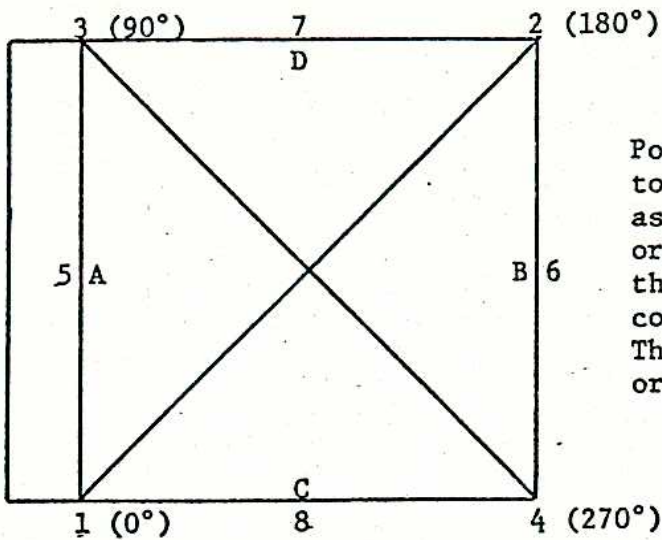
VI. Magazine Platen

The platen mounted in Fairchild film magazine No. 52-468 does not depart from a true plane by more than 13 μ m (0.0005 in).

III. a. Resolving Power in cycles/mm Area-weighted average resolution 48.6
Aperture f/11.

Field angle:	0°	7.5°	15°	22.5°	30°	35°	40°	45°	50°	54.5°
Radial lines	99	83	70	59	70	83	99	42	21	21
Tangential lines	99	70	59	49	42	42	59	70	59	42

VII. Principal Point and Fiducial Coordinates



Positions of all points are referenced to the principal point of autocollimation as origin. The diagram indicates the orientation of the reference points when the camera is viewed from the back, or a contact positive with the emulsion up. The direction-of-flight fiducial marker or data strip is to the left.

	<u>X coordinate</u>	<u>Y coordinate</u>
Indicated principal point, corner fiducials	-0.016 mm	-0.006 mm
Indicated principal point, midside fiducials	-0.014	-0.003
Principal point of autocollimation	0.0	0.0
Calibrated principal point (point of symmetry)	0.003	0.000

Fiducial Marks

1	-106.007 mm	-105.999 mm
2	105.977	105.987
3	-106.010	105.988
4	105.978	-105.999
5	-110.005	-0.003
6	109.981	-0.003
7	-0.013	109.986
8	-0.015	-110.000

VIII. Distances Between Fiducial Marks

Corner fiducials (diagonals)

1-2 299.792 mm 3-4 299.795 mm
 Lines joining these markers intersect at an angle of 89° 59' 59"

Midside fiducials

5-6 219.985 mm 7-8 219.987 mm
 Lines joining these markers intersect at an angle of 89° 59' 58"

Corner fiducials (perimeter)

1-3 211.987 mm 2-3 211.987 mm
 1-4 211.985 mm 2-4 211.986 mm

The method of measuring these distances is considered accurate within 0.005 mm.